

had opened barrels of gasoline, were suddenly overcome by the fumes and plunged "head first" into the oil. Large gasoline tanks which have been recently emptied are dangerous for men to go into, and require about twenty-four hours of ventilation before they are safe for a human being to enter.

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ON THE MISUSE OF THE TERMS PARAPTERON, HYPOPTERON, TEGULA, SQUAMULA, PATEGIUM AND SCAPULA.¹

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One of the terms most frequently misapplied by writers on insect morphology, is the designation parapteron. Each of the lined areas in fig. 2 (*i. e.*, *pa*, *pas*, *prs*, *aba*, *pba*, and *aes*) as well as the sclerites *sur*, *npt*, and *sa* have been designated as the "parapteron." Since it is quite evident that all of these cannot be so termed, without creating confusion, it may be of some interest to attempt to establish the correct application of the designation parapteron, as intended by its author.

¹ Contribution from the Entomological Laboratory of the Massachusetts Agricultural College, Amherst, Mass.

In its Gallicized form "paraptere," the term was first used by Audouin, '24. In his figures of the thoracic sclerites of *Dytiscus* (the only insect used to illustrate his paper) Audouin clearly and unmis-takably designates as the "paraptere," the sclerite labelled *hyp* in fig. 3 (of the present paper). Audouin, '24 (page 420) likewise describes the "paraptere" as a sclerite which "unites dorsally with the episternum and epimeron to form a support for the wings and tergum"—a description which applies to the sclerite *hyp* (fig. 3) alone, as can be seen by glancing at his figure of *Dytiscus*' mesothorax.

On page 122, Audouin, '24, states that in his previous publicaitons he had designated the sclerite in question (which "is always supported by the episternum, and sometimes prolonged ventrally along the anterior margin of the latter") as the "*hypopterc*." Having extended his studies, however, and having found that in other insects, there exist certain plates which he considers as representing these plates although they are not situated below the wing (and may sometimes even "pass in front of the wing and take up a position above the base of the latter"—*i. c.*, may occupy the position of the sclerite *tg*, figs. 2 and 6), Audouin states that he now prefers to change the term hypo-pterion (*i. c.*, "under-the-wing") to para-pterion (*i. c.*, "near-the-wing"), in order to signify its changing position in relation to the wing base. In other words, he erroneously considers that certain sclerites above the base of the wing (*i. c.*, the tegulæ, *tg*, figs. 2 and 6) are homologous with the hypopteron (*hyp*, of figs. 2 and 3), and includes them all under the general designation parapteron.

Audouin's own words on the subject are as follows (Audouin, '24, page 122) as translated by Snodgrass, '10^a (foot-note to pages 20 and 21) . . . "finally there exists a piece but little developed and seldom observed, connected with both the episternum and the wing. It is always supported by the episternum and is sometimes prolonged ventrally along its anterior margin, or again, becoming free, passes in front of the wing and may even come to lie above the base of the latter. At first we designated this sclerite by the name of hypopteron, but on account of its change of position relative to the wing base, we now prefer the name of parapteron." And again (Audouin, '24, page 420) . . . "the episternum, the parapteron and the epimeron all fuse dorsally and constitute a support for the wings and tergum."

It is clearly evident that this reference to a sclerite which is

"always supported by the episternum, and is sometimes prolonged ventrally along the anterior margin of the latter" is applicable to the sclerite *hyp* (fig. 3) alone. Furthermore, it alone, of the sclerites described by Audouin, conforms to the statement that . . . "the parapteron, the episternum, and the epimeron all unite dorsally to constitute a support for the wings and tergum." Lastly, the only sclerite designated as the parapteron in the figures accompanying Audouin's work, is the region *hyp* in the mesothorax of *Dytiscus* (fig. 3 of the present paper) where Audouin clearly and unmistakably labels this sclerite the "paraptere." In the face of such conclusive evidence, it hardly seems possible that any one who is capable of analyzing Audouin's definition of the parapteron, or who will take the trouble to glance at his labelled figure of the mesothorax of *Dytiscus* (the only insect used to illustrate his paper) will be prepared to deny that the sclerite *hyp* (figs. 2 and 3) is the one referred to in the first part of Audouin's definition of the parapteron.

Having thus established beyond all peradventure, the identity of the sclerite to which Audouin intended that the first part of his definition of the "paraptere" should apply, the next question to be determined, is what sclerite did Audouin have in mind in the second part of his definition of the "paraptere," in which he speaks of it as "becoming free and passing in front of the wing to take up a position above the base of the latter." The only sclerite which conforms to this part of the definition of the "paraptere," is the tegula, *tg* (figs. 2 and 6). It occupies a position slightly in front of and above the base of the wing, thus fitting the latter part of Audouin's definition perfectly.

If there were any grounds for doubting that Audouin here refers to the tegula, *tg*, they would be immediately dispelled by Audouin's clear and definite statement concerning the matter, in a footnote to his translation of MacLeay's article on the thoracic sclerites of the wasp *Polistes*. The footnote (Audouin, '32, footnote to page 41 of author's separate, or to page 135 of the "Annales" may be translated as follows . . . "in fact, I consider as the parapteron, the little plate so easily seen covering the base of the fore wings in the Hymenoptera and Lepidoptera, designated as the scale, epaulet, or squamula. Mr. MacLeay labels it *a*, in his figures 1, 2 and 4." This statement is certainly lucid and definite enough to satisfy the most skeptical, and one

needs but to refer to the figures in question, to verify the statement that the tegula is here intended (the tegula was formerly referred to as the scale, epaulet, or squamula).

Professor C. H. Fernald has very kindly called my attention to another work (Audouin, '40) in which Audouin both figures and defines the tegula, *tg* (of the Pyralidæ) as the "epaulette ou paraptere." Thus all of the evidence to be adduced from Audouin's definitions and figures, merely serves to confirm the opinion of those who maintain that Audouin's definitions of the "paraptere" refer to both of the sclerites *tg* and *hyp* (figs. 2, 3, and 6) which Audouin incorrectly considered as homologous, and included under the same name.

Since Audouin at first (Audouin, '20) referred to the sclerite *hyp* alone as the hypopteron, and only later (Audouin, '24) incorrectly includes it, together with the tegula, *tg*, under the designation parapteron, through a misunderstanding concerning the true homologies of the sclerites in question, the most logical course of procedure would be to retain the designation hypopteron for the sclerite *hyp* (figs. 2 and 3) as originally used by Audouin, and to restrict the designation parapteron, to the tegula, *tg* (figs. 2 and 6) as was later done by Audouin, '40, making it a synonym of epaulet, or tegula.

This method of procedure has much to recommend it. In the first place, as we have seen, Audouin (the author of the term) himself makes the designation parapteron synonymous with the terms then applied to the tegula (*i. e.*, scale, squamula, or epaulet). In the second place, Audouin's contemporaries (*e. g.*, Lyonnet, '32, Westwood, '38 and many others) adopted this usage, and applied the designation parapteron to the tegula, thus showing that this usage was in vogue even in Audouin's day, and had his sanction. In the third place, this usage (*i. e.*, of applying the term parapteron to the tegulæ) is extremely widespread, and is generally accepted by writers of various nationalities. And lastly, this usage is sanctioned by many modern works of reference—*e. g.*, Packard, '98, Sharp, '99, Henneguy, '04, Smith, '06, Folsom, '06, Houlbert, '10, Jardine, '13, Comstock, '13, and many others.

From the foregoing discussion, it is clearly evident that the term parapteron should be applied to the tegula alone (as a synonym). The grounds for so doing have been given in detail, because some recent writers do not think that there is sufficient justification for

restricting the term parapteron to the tegula, and insist upon designating other sclerites by this term—a course of procedure which unnecessarily complicates matters, and merely serves to heighten an already sufficiently disconcerting confusion in the application of morphological terminology.

Snodgrass, '08, terms the plate *aba* (fig. 2) the "first or anterior parapterum," and designates the plate *pba* (fig. 2) as the "second, or posterior parapterum." Later, Snodgrass ('09_b) likewise includes the plates *sa* (Fig. 2) under the general designation paraptera, terming them the "epimeral paraptera." In a lengthy footnote to pages 20 and 21 of his "Anatomy of the Honey-Bee," Snodgrass, '10_a, seeks to justify this usage of the term parapteron, on the ground that (in his opinion) Audouin, '24, referred to the plates *aba* and *pba* in his definitions of the parapteron, and that this term should be extended to include the subalar plates *sa* (fig. 2) as well.

The only reason given by Snodgrass for thus arbitrarily applying the terms paraptera to the wrong plates, is the incorrect statement that Audouin had these plates in mind when he described the paraptera in the passages quoted above. That this supposition is absolutely wrong, has already been demonstrated, and Snodgrass's charge that . . . "modern writers such as Packard and Folsom who make the term paraptera synonymous with tegulae are certainly wrong" (Snodgrass, '10_a footnote to page 21) was evidently made without consulting all of the available evidence, else so keen an observer as he would never have committed such an obvious error.

The incorrect application of the term parapteron to the little plates under the wing, and at its base, is apparently traceable to Lowne, '90, who designates the plate *aba* (figs. 2 and 5) as the parapteron. Hewitt, '70, who accepts Lowne's interpretations in most instances, designates this plate as the "parapterm," apparently meaning to call it the parapteron. According to Snodgrass, Comstock regards one of the basalar sclerites (*aba* or *pba*) as the parapteron, but I have been unable to verify this statement. Berlese, '06-'09, applies the term "parattero" (*i. e.*, parapteron) to the sclerite *sa* (fig. 2), but all of these usages are incorrect.

Other incorrect applications of the designation parapteron, are as follows. Hammond, '81, applies the term parapteron to the sclerite *acs* (figs. 2 and 5), suggesting that it may be the "paraptere" de-

scribed by Audouin; but he is not certain of this point. That Hammond's surmise is incorrect, has already been demonstrated.

Landacre, '02, incorrectly applies the term paraptera to the little ossicles *npt* (fig. 2) at the base of the elytra of the beetle *Passalus*, and Newport, '39, misapplies the term parapteron to the sclerite *sur* (fig. 2) in his figure of the thorax of the beetle "*Hydrous*," although in his figures of the thorax of *Sphinx* and *Ichneumon*, he quite correctly refers to the tegulæ as the paraptera.

Emery, '00, designates the region *prs* (figs. 2 and 6) as the "parattero del mesonoto," in the thorax of various ants. It is perhaps superfluous to add that this usage is also incorrect.

Escherich, '06, who reproduces Emery's figures of the thorax of ants, terms the plate *prs* (figs. 2 and 6) the "proscutellum." The designation proscutellum, however, should always denote the scutellum of the prothorax (if such exists) so that it is necessary to change the term proscutellum to prescutellum, in referring to the sclerite *prs*. The latter term is evidently the one Escherich intended to use.

The unfounded statement that MacLeay, '30, applied Audouin's term parapteron to the tegulæ, is frequently made (*e. g.*, Jardine, '13, page 156; Snodgrass, '09b, page 581; Packard, '98, page 89; and others). It is difficult to understand how such careless statements can be made, for MacLeay, '30, did not call the tegulæ "paraptera," at all. He calls them "squamulæ," and attributes this usage to Latreille. Latreille, however, called them "pterygodes." Any one who will take the trouble to read MacLeay's descriptions, and look at his figures, will readily see that the sclerites which he designates as the "paraptera" are not the tegulæ at all. Thus in *Polistes*, MacLeay states that the mesothoracic plates (which he terms the parapsides) designated as *pa* in fig. 2 (of the present paper) are possibly the prothoracic paraptera pushed back out of place! He gives no reasons for this view. The plates which MacLeay designates as the mesothoracic paraptera are the sclerites *pas* (fig. 2), one on either side of the scutellum. The sclerites which he designates as the meta-thoracic paraptera are the lateral portions of the entire metanotum, in which the subregions have united to a greater or less extent, and have then become divided into a median and two lateral regions (one on either side) by the formation of secondary sutures, or those not originally present. Thus, the only sclerites regarded as the "parap-

tera," by MacLeay are those designated as *pa* and *pas* in fig. 2, as well as the entire lateral region of the metanotum, so that the statement that MacLeay, '30, referred to the tegulæ as the paraptera is wholly unfounded—although it would have been entirely correct for MacLeay to have termed the tegulæ paraptera, had he chosen to do so. It is perhaps superfluous to add, that the sclerites which MacLeay actually did designate by the term paraptera, were incorrectly designated.

With regard to the application of the term hypopteron, certain writers (Smith, '06) would make it, together with the term parapteron, synonymous with tegula (*tg* of fig. 6). The term hypopteron, however, means "*under-the-wing*," and is wholly inapplicable to the tegula, which is situated *above* the wing. As originally used by its author (Audouin, '20), the designation hypopteron was applied to the sclerite *hyp* (fig. 3), for which it is a very appropriate designation. It was only later, and due to a mistaken interpretation of the sclerites, that Audouin, '24, included the region *hyp* together with the tegulæ, under the designation parapteron, so that it would be perfectly logical and appropriate to restrict the term hypopteron, to the sclerite *hyp*, and to make the term parapteron synonymous with tegula.

Snodgrass, '09_b, figures the hypopteron (*hyp* fig. 3) in his illustrations of the thoracic sclerites of the Coleoptera (Snodgrass, '09_b, figs. 106, 107, etc.) but does not designate it by any name, in the Coleoptera. In his fig. 70, of the mesopleuron of the grasshopper *Dissosteira*, however, he designates a sclerite homologous with the hypopteron, as the preepisternum. This is the only case in which Snodgrass uses the term preepisternum correctly. For example, in his figure 29, of the prothorax of the roach *Byrsotria*, the plate designated as the "preepisternum," corresponds to the fusion product of sclerites *lpl* and *lst* (fig. 2, of the present paper). On the other hand, in his figure 94, of the mesopleuron of the earwig *Spongiphora*, he applies the term preepisternum to the plate *lpl* (fig. 2, of this paper) alone, and in his figure 35, of the mesothorax of the roach *Ischnoptera*, he designates as the preepisternum, the plate *aba* (fig. 2) alone. The term preepisternum was first used by Hopkins, '09, who correctly applied it to the hypopteron (*hyp*, fig. 3) of the beetle *Dendroctonus*. As used by its author, the designation preepisternum would therefore be synonymous with hypopteron, which should be applied to the sclerite *hyp* (figs. 2 and 3) alone.

In his paper on the "Thorax of the Hymenoptera," Snodgrass, '10_b, introduces a new synonym for the hypopteron *hyp* (fig. 2), designating it as the "prepectus," and giving as his reason for so doing, that in the Hymenoptera, he thinks that this sclerite is a new formation, not homologous with the "preëpisternum" described in his previous papers. In his own words (Snodgrass, '10_b, page 78) . . . "though the prepectus has something the appearance of the preëpisternum of the more generalized orders of insects, especially if we assume a continuity between the prepectus and the presternum, yet the phylogentic gap between them is too great to permit the homologizing of one with the other. The prepectus of the Hymenoptera appears to be a purely secondary production within this order."

Now, as we have seen, Snodgrass confused the homologies of the sclerites which he designated as the "preëpisternum," applying this term to totally different sclerites in different insects. Under these conditions, it is very natural that some of these incorrectly designated sclerites which he terms the "preëpisternum" (such for example, as the plate *lpl*, of fig. 2, of the present paper—which he terms the "preëpisternum" in his figure 94, of the earwig) are not homologous with the sclerites which he terms the prepectus, in his Hymenopteron paper (*i. e.*, the sclerite *hyp*, fig. 2). The sclerite which Snodgrass, '09_b, terms preëpisternum, in his figure 70 of the grasshopper *Dissosteira*, however, is most assuredly the homologue of the "prepectus" of his Hymenopteron paper. Furthermore, the author of the term preëpisternum (Hopkins, '09) applied it to a sclerite of *Dendroctonus*, homologous with the sclerites designated as the prepectus in Snodgrass's Hymenopteron paper. The terms preëpisternum and prepectus are therefore synonymous, and both are synonyms of the designation hypopterton, applied to the sclerite *hyp* (fig. 3) by Audouin, '20.

Jordan, '02, terms the sclerite *hyp*, the "peristernum," in his figures of the grasshopper *Acridium* and the beetle *Meloe*. Enslein, '12, terms it the "praesternum" in his figure of the sawfly *Tomostethus*, apparently not realizing that the term presternum is used to designate a sclerite of the sternal region.

From the foregoing discussion, it is apparent that the only logical course of procedure is to retain the designation hypopteron, for the sclerite *hyp* (fig. 3) as originally used by its author Audouin, '20.

Since the term hypopteron is sometimes incorrectly applied to the teguke, it might possibly be preferable to designate the sclerite *hyp* (fig. 3) as the preëpisternum, as is done by Hopkins, '09; or to designate it by Snodgrass's term prepectus, which is an extremely expressive and appropriate one—this, however, is purely a matter of personal preference.

The term teguke should be applied only to those sclerites homologous with the little shell-like scales (figs. 2, 4, and 6, *tg*) situated slightly above and in front of the base of the mesothoracic wings, easiest seen in the Hymenoptera and Lepidoptera.

In his work on the thoracic sclerites of the blowfly, Lowne, '90, applies the term epaulet to "a large scale fringed with black bristles" and states that it "does not correspond with the tegula of the Hymenoptera" (Lowne, '90, page 200). In some of Lowne's figures it is very difficult to determine exactly to what sclerite he intends that his designation epaulet should refer; but in his figure 5, of plate X, the "epaulet" is clearly the teglua (*tg* fig. 4, of the present paper) and despite Lowne's statement to the contrary, it is homologous with the tegula of the Hymenoptera (fig. 6, *tg*).

Since Loew, '62, and other Dipterologists after him, have very inconsiderately applied the term teguke to the so-called calyptra of Rondani, '56 (or the two lobe-like expansions of the hinder margin of the wing membrane, near its base—fig. 4, *dc* and *pc*), it might perhaps be preferable to employ the term epaulet to designate the true teguke, *tg* (fig. 4) in the Diptera, and thus avoid ambiguity. This usage is sanctioned by Audouin, '40, himself, who, together with Chabrier, '20, and many of the earlier French writers, use the designation "epaulette" as a synonym of the terms applied to the teguke of various insects.

The term squamula was applied to the tegulae, *tg* (figs. 2 and 6) by MacLeay, '30, (who attributed this usage to Latreille) and this usage has been adopted by a few subsequent writers. This misapplication of the term, however, is very unfortunate, since the designation squamula has been used by many Dipterologists, to denote one or both of the calyptra (fig. 4, *dc* and *pc*) mentioned above.

Linné, 1758, who introduced the term squamula, applied it to the calyptra, although it is impossible to tell from his description, whether he intended to apply the term to one, or to both of the calyptra.

Curtis, and a number of other Dipterologists apply the designation *squamulæ* to both calyptra. Lowne, '90, however, restricts the term *squamula* to the distal calypter (*dc*, fig. 4), termed the *antisquama* by Osten-Sacken, '96, and designates the proximal calypter (*pc*) as the *squama*.

A number of Dipterologists use the designation *squama* for one or both of the calyptra (*c. g.*, Erichson, Fabricius, Fallen, Illiger, Meigen, Scheiner, Say, Zetterstedt—and many others) so that the terms *squama* and *squamula* should be applied to the calyptra, and not to the tegulæ, if these terms are to be used at all. In addition to applying the designation *squama* to the tegulæ, some writers have also applied it to a sclerite of the head region, to a genital sclerite, and to the apparent first abdominal segment (the knot or scale at the base of the abdomen) in ants.

The term *patagium* is incorrectly applied by Lowne, '90 (page 198) to the posterior, or anal region of the wing. Fortunately, this incorrect usage was not accepted by Dipterologists, or the confusion in the use of this term would have been unnecessarily increased.

Kirby and Spence, '26, correctly restricted the term *patagia* to the erectile lobe-like appendages borne on the pronotum of certain Lepidoptera (fig. 1, *pat*), and attributed this usage to Mouffet, 1634. These prothoracic structures occur on the pronotum alone, and are not homologous with the tegulæ (figs. 4 and 6, *tg*) which are mesothoracic structures having nothing in common with the *patagia*. Riley, '04, called attention to this fact,² a number of years ago as did Chlodowsky and many others before him, but Lepidopterologists have disregarded this fact, and still continue to apply the term "*patagia*" to the tegulæ. If the tegulæ are called "*patagia*," what are we to term the true *patagia*, when both the *patagia* and tegulæ are present in the same insect, as in *Agrotis*, for example? Some such designation as "*propatagia*" might be used to distinguish the prothoracic structures from the tegulæ; but this would be quite unnecessary, if the original and correct application of the terms *patagia* and tegulæ were adhered to.

² In an article entitled "*Das Pronotum und die Patagia der Lepidopteren*," published in the *Deutsch. Ent. Zeit.*, Schultz, 1914, has recently called attention to this point, and has shown that the true *patagia* are in no wise homologous with the tegulæ.

Kirby and Spence, '26, very clearly state that the patagia are prothoracic structures, and that the tegulæ are mesothoracic. They likewise apply the designation patagia to the true patagia, and the designation tegulæ to the true tegulæ, so that the commonly accepted statement made by Newport, '39 (page 923) that Kirby and Spence term the tegulæ "patagia," is wholly false and unjust. The unfortunate confusion caused by the interchanging of the terms patagia and tegulæ, is not attributable to Kirby and Spence; but is due to the ignorance, or carelessness of later writers.

The designation scapula (or scapulæ) and scapularia have been very frequently misapplied by workers in different orders or in different families of the same order of insects. Thus the term scapula has been applied to the patagia, tegulæ, etc., of Lepidoptera, to the antero-lateral sclerites in the mesonotum of Proctotrypidæ, to the postero-lateral sclerites in the mesonotum of Coleoptera, to the lower lateral region of the mesonotum of Hemiptera, to the trochanter of the anterior leg in various insects, and to the whole, or a portion of the mesopleuron of certain Hymenoptera and Coleoptera. The last mentioned usage conforms to that of Knoch, 1801 (Neue Beitræge) who introduced the term, so that it is preferable to restrict it to the pleural sclerites.

SUMMARY.

The points brought out above may be briefly summarized as follows.

The term **paraptera** should be applied only to those sclerites homologous with the shell-like scales situated slightly in front of, and above the bases of the mesothoracic wings (best seen in Hymenoptera, Lepidoptera, etc.) . . . *tg* of figs. 2 and 6. These are not homologous with the patagia—which are prothoracic structures (*pat* of fig. 1) having nothing in common with the paraptera. Synonyms of paraptera are tegulæ, pterygodes, and epaulets. (The terms squamule, patagia, scapulæ, humeri, etc., sometimes applied to the structures in question, are misapplied.)

The term **hypopteron** should be restricted to the narrow region extending along the anterior margin of the pleuron in certain Coleoptera, Orthoptera, Hymenoptera, etc. (*hyp* of fig. 3). Synonyms of hypopteron are peristernum, præpisternum, and prepectus.

The term **tegulæ** should be restricted to the structures referred to above, as the paraptera, or epaulets.

The term **squamulæ** should be restricted to the lobe-like expansions of the posterior margins of the mesothoracic wings, near their bases (*pa* and *da* of fig. 4). As thus used, the designation *squamulæ* is synonymous with *calyptra* (sometimes called "calyptra," and *calyp-teres*) and *squamæ*.

The term **patagia** should be applied only to the lobe-like tergal structures of the pronotum of certain Lepidoptera, etc. (*pat* of fig. 1). These are not homologous with the *tegulæ* (*tg* of fig. 6). The designation *propatagium* may be used as a synonym, if there is any danger of ambiguity.

The term **scapulæ** should be applied only to the pleural sclerites.

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